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Analysis of physico-chemical parameters of water quality in and around Saltpans of Prakasam (Dt.) A.P

B. Lalitha kumari*[1], P. Sudhakar[2], M. Hanuma sri[3] and K.P.N.V. Satya Sree[4]

*[1]Asst.Prof., S&H Dept., Vignan University, Vadlamudi, Guntur(Dt.), A.P. India
[2]Asst.Prof. Dept. of Biotechnology, ANU,Guntur, A.P.
[3]Pharmist, KLE University, Belgaum, Karnataka.
[4] Asst.Prof. in Vignan Nirula Engineering,College for Women, Palakaluru, Guntur, A.P.

Abstract

One of the greatest challenges of the 21st Century is to provide an adequate supply of safe drinking water for house hold consumption to everyone. But today water pollution is the biggest problem for Human beings which deteriorates the water quality. Bore well and open well water were selected for analysis in the present study located in and around salt pans of Oollapalam and Ooguru of Prakasam (Dt.)in A.P. The potability, salinity and Water Quality Index of available water sources in that area were estimated in the present study. The analysed Physico-chemical Parameters in collected water were, pH,conductivity(mmhos),turbidity,total solids,total dissolved and suspended solids,total hardness,Ca & Mg hardness,chlorides,alkalinity,nitrates,sulphates, phosphates,DO,BOD & COD,Bo,Na,K etc. All these were analysed in mg/l and at last Sodium Absorption Ratio (mmol/l) was also calculated. All these were calculated by below mentioned formulas. The findings clearly indicated that saline effluent has polluted water and the results obtained indicate us that the detrimental impact of saline effluent on water quality rendering it unsuitable for the propagation of life and is unfit for agricultural purposes.

Keywords: Physico-chemical parameters, conductivity, turbidity, Do, BOD, COD, SAR, WQI.

INTRODUCTION

One of the greatest challenges of the 21st Century is to provide an adequate supply of safe drinking water for house hold consumption to everyone. But the quality of water resources are unevenly distributed over the earth's surface & this is deteriorating due to anthropogenic activities, so in future even countries are going to suffer from scarcity of pure water. As we dump municipal wastes and industrial waste, heavy land and salt making properties of ground water change. Therefore it is essential to analyze the ground to study the variations in connection with quality parameters. Based on the physico- chemical parameters quality could be rated based on uses like Drinking , Agriculture , Industrial etc.for the insidious and effective use and get documented for further references (Alagmutuhu and Rajan, 2008).

Rapid urbanization and Industrialization started culmination of water, air and land pollution (Hariharan, 2007). Today water pollution is the biggest problem for Human beings which deteriorates the water quality. Various Human activities make water unfit for drinking and domestic purposes. The main sources of water pollution are chemical fertilizers and pesticides getting in an untreated sewage and industrial effluents into rivers and streams, running close to the cities and low lands. Many dangerous diseases are caused by using polluted water (Garg et al ., 2007), by reducing the incidence of many water borne communicable diseases. The diseases associated with contaminated water cause serious public health problems in India (Tambekar, 2007). Salinization of coastal fresh water aquifers by seawater intrusion, geomorphic changes, tidal waves, cyclonic storms and man-made hazards are major causes in the coastal areas of the state of Andhra Pradesh, India.

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*Corresponding Author
B. Lalitha kumari
Asst.Prof., S&H Dept. Vignan University, Vadlamudi, Guntur(Dt.), A.P. India

Tel: ; Fax:
Email: lalithayadlapalli@rediffmail.com

SCOPE OF THE STUDY

Prakasam district of A.P.and is renowned for the production of salt from brine and salt making is livelihood for the resident of the same. The prepared salt is used locally for domestic consumption as fertilizer, as soil conditioner, as repellent, as fermenting agent for salting green mangoes, in ice plants and also used for curing dry fish. Here usually people use bore well water for drinking, agriculture and industries. Bore well water & open well were selected for analysis in the present study located in and around salt pans of Oollapalam and Ooguru.

OBJECTIVES

- To assess the potability of available water sources in and around the salt pans of Oollapalam and Ooguru.
- To estimate the salinity of available water sources with references to salt making.
- Calculations of Water Quality Index (WQI) to predict the potability of water samples.

MATERIALS AND METHODS

Oollapalam is situated in Prakasam district, A.P. The water samples were collected in and around the saltpans of the same. This place has around thirty five saltpans. Water samples were collected from above cited area & collected water samples were brought to the laboratory for analysis.Then the Physico-chemical Parameters of the water samples were analysed in triplicate by adopting standard procedures from manual of American Public Health Association(1998). The analysed Physico-chemical Parameters in collected water were, pH,conductivity(mmhos),turbidity,total solids,total dissolved and suspended solids,total hardness,Ca & Mg hardness,chlorides,alkalinity,nitrates,sulphates, phosphates,DO,BOD & COD,Bo,Na,K. All these were analysed in mg/l and at last Sodium Absorption Ratio(mmol/l) was also calculated.

1. pH values were estimated by the electrometric method.
2. Conductivity of the samples were read by conductivity meter.
3. Turbidity was determined by Nephelometric Turbidity Meter and was expressed in terms of NTU.
4. Total solids and total dissolved solids were calculated by,
   Total solids(mg/l) = (A-B)x1000/V
5. Total suspended solids were calculated by,
   Total solids – Total dissolved solids
6. Total hardness was calculated by,
   ml of EDTA used X 1000/vol.of sample taken
7. Calcium hardness is calculated by,
   Total hardness-Calcium hardness.
8. Mg hardness is calculated by,
   Total hardness-Mg hardness.
9. Amount of chlorides are calculated by,
   Chloride mg/l=(A-B)X N X 35.45X1000/V
10. Alkalinity is calculated by two methods:
    a. total alkalinity
    b. phenolphthalein method
       Total Alkalinity =A or B X N X 50,000/V
11. Nitrates are calculated by,
    Nitrates=1000 X Conc.From Graph/Vol.of sample taken
12. Sulphates are Calculated by,
    Sulphates=1000 X Conc.From Graph/Vol.of sample taken
13. Phosphates are Calculated by,
    Phosphates=1000 X graph value in mg/V
14. D.O is Calculated by,
    DO=(ml X N) of sodium Thiosulphate X 8000/Vol. of sample.
15. B.O.D is calculated by
    Depletion in DO in 5 Days(Y)=DO of sample –DO of blank
    BOD at 20Degrees(mg/l)=Vol.of bottle x Y /Vol.of sample taken.
16. C.O.D is calculated by,
    COD=(Rb-Rs) x N x 8000/Vol.of sample
17. Boron is calculated with Carmine reagent.
18. Sodium & potassium were calculated with Flame Photometer.
19. SAR is calculated by,
    $SAR=[Na^{+}] / [Ca^{+2} + Mg^{+2}]^{1/2}$ = nmol/l

RESULTS AND DISCUSSION

Results of physico – chemical parameters of water samples were represented in tables 1&2. PH values below 4 generally produce sour taste and values about 8.5 show alkaline taste (Karunakaran, 2008). A pH range of 6.5 and 8.5 is normally acceptable as per BIS (1983) and WHO(1984). It was observed from pH values that the water samples of Oollapalem were alkaline varying from 7.56 - 9.91 and these values were above permissible limit as prescribed by CPCB (1991). Water samples near salt pans (W2,W3) showed high values of pH (8.36& 8.8), which may be due to seepage of salt water from salt pans long back (table-1).Water samples collected from Ooguru showed the pH ranging from 6.65-8.60(WW2-WW3)(Table-2). The electrical conductivity values are an index to represent the concentration of soluble salts in water. Electrical conductivity in all samples were observed in a range of 3.48-87.4(Table-1). Conductivity of water sample in the Ooguru region was found to be between 2.08-2.91 mmhos(WW2,WW3). It was observed that water with high electrical values were predominant in Sodium and chloride ions.

Hardness is caused by multivalent metallic cations which are the divalent ions like Ca, Mg, Strontium, Ferrous and Mn. The hardness of water was derived when it comes in contact with the soil and rock formations.Ca and Mg hardness is caused by far greatest portion of the hardness occurring in natural waters. Hardness of water was objectionable from the view point of water used for laundry and domestic purpose since it consumes a large quantity of soap. Ordinary salts of Ca & Mg Contribute to total Hardness. Total hardness reported from Oollapalem water samples as 450-520mg/l (W3,W4), Ca hardness was reported as 420-500mg/l (W3-W4) and Mg hardness as 320-400mg/l (W3-W4) (Table-1).The water samples from Oollapalem were found to exceed the permissible limits of hardness. This was due to the presence of high Ca content in these places (Foppen, 2002).The water samples of Ooguru showed total hardness of240-370mg/l, Ca hardness of 120-300mg/l and Mg hardness of(150-800mg/l)(WW2-WW3) (Table-2). All these were below the prescribed standards.

The alkanity of water is a measure of its capacity to neutralize acids.Alkainity value provide guidance in applying proper doses of chemicals in water and waste water treatment processes, particularly in coagulation, softening and operational control of anaerobic digestion. There is no standard value for total alkalinity. The total alkalinity value indicates poor water quality. The high value of alkalinity was due to sea water. Water collected from Oollapalem showed Maximum value of 12.5mg/l (W2).The alkalinity of Ooguru water samples ranged 1.5-3mg/l(W2,W3) (Table-2).(Kulshreshtha et al., 2004).Chlorides are important in detecting the contamination of ground water by waste water. In general high evapotranspiration tends to increase the Chlorides and salinity at the root zone of irrigated plants, making it difficult for crops to take up the water due to osmotic pressure differences between the water outside the plants and within the plant cells (Hariharan, 2007). For this reason Chlorides and total salinity concentration below the drinking water standards are normally specified for waters used to irrigate salt senstive crops (Alagamuthu and Rajan, 2008). All water samples collected from Oollapalem showed Maximum value of 524.83,389.87mg/l (W2-W3) (Table-1).The prescribed standard limit for Chlorides is 250mg/l for domestic purposes and the Chloride Concentration in water samples of Ooguru reported below permissible limits (67.07-49.18mg/l) (Table-2).

Table 1. Physico - Chemical Parameters of water samples collected at Oollapalem, Prakasam (Dt.) A.P.

Parameter	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10
pH	9.24	8.36	8.9	9.91	9.80	9.92	9.5	9.34	7.79	7.56
Conductivity (mmhos)	58.4	4.85	3.48	85.1	87.4	84.5	61.0	62.3	---	2.53
Turbity(NTU)	8.5	8.5	8.3	8.4	8.6	9.7	10.7	12.5	16.4	8.4
Alkalinity(mg/l)	50	12.5	10	30	25	35	85	35	175	7
Total hardness(mg/l)	2000	300	450	520	620	550	500	890	900	180
Ca hardness(mg/l)	500	300	420	500	600	900	300	2000	400	50
Mg hardness(mg/l)	2000	250	320	4000	6000	4200	4500	4500	7600	230
Total solids(mg/l)	10.16	8.56	8.43	8.1	9.93	61.8	10.3	10.36	150.0	31.76
Total dissolved solids(mg/l)	31.6	7.6	12.83	14.56	21.36	18.43	37.23	71.6	510.1	15.7
Total suspended solids(mg/l)	24	1.04	5.6	20.46	9.7	12.63	33.8	7.76	39.1	16.06
Chlorides(mg/l)	549.7	524	389	249.9	569.3	349.9	299	469	214.9	24.99
Nitrates(mg/l)	0.2	4.13	3.5	0.3	0.2	0.36	3.3	1.73	2.73	0.9
Phospates(mg/l)	0.76	10.4	4.266	1.03	0.63	0.66	1.12	1.2	12.23	2.13
sulphates(mg/l)	57.2	22.56	22.43	32.43	34.92	38.46	63.56	69.66	60.5	3.86
D. O (mg/l)	1.7	3.6	2.9	7.1	7.4	7.2	2.9	2.9	3.3	0.2
B.O.D (mg/l)	1.1	1.4	0.16	2.2	1.4	2.2	2.9	2.3	1.9	0.3
C.O.D(mg/l)	1.5	1.8	3.6	2.2	3.6	4.8	4.5	4.8	4.2	0.5
Bo(mg/l)	0.86	0.79	0.71	0.71	0.85	0.78	0.61	0.39	1.93	0.40
Na(mg/l)	1282	228	189	1286	1253	2089	1447	1160	2154	100
K(mg/l)	200.5	106.5	83.8	157	158.6	172.9	104	219.8	263.1	1.4
SAR(mml/l)	29.60	13.8	12.6	30.8	30.88	32.04	28.94	28.00	24.60	12.2

All water samples found to be free from Sulphate pollution and showed sulphate concentration ranging from 22.56-22.163 mg/l(W2-W3), which are with in permissible limits according to CPCB(1991) (Table -5). Similar results were observed from Ooguru water samples. The maximum allowable limit of Nitrate in drinking water is 45 mg/l (CPCB, 1991). It was found that all water samples of Oollapalem were free from Nitrate pollution as the amount of nitrate varies from 3.5-4.1mg/l(W2-W3) (Table-1). Phosphates are of great importance in drinking water and the quantity of phosphates in water indicates the degree of water pollution. The phosphate concentration in water samples of Ooguru village were normal that is within range (0.24-0.1mg/l)(Table-2). As per CPCB (1991)&WHO(1984) guidelines there was no specific permissible limit for phosphates. All the water samples were collected Oollapalem found to have low D.O content ranging from 2.92-3.6mg/l and similar results were observed in Ooguru samples (Table-1&2). BOD is measure of organic pollution. All water samples showed BOD values within the range of 0.16-1.4mg/l. However these values were well below the prescribed limit. There is no permissible limit for COD of drinking water. All water samples found to have low COD values ranging from 1.8-3.6mg/l (Table-1&2).

One water sample of Oollapalem (W2) and one water sample of Ooguru (WW3) showed maximum of Na concentration(228 & 225 mg/l) (Table -1&2) (Cardona et al., 2004). All the water samples showed the values of K ranging from 83.8-106.1mg/l (table-1& 2). Calculations of SAR for water provides a useful index of Na hazards in water, soils and crops. Low SAR (2-10) indicates little danger from Na, medium hazards betwwen 7-18 , high hazards between 11-26 and very high hazards i.e. the lower the ionic strength of the solution, the greater the Na hazards for given SAR (Richard, 1954). Oollapalem water samples showed SAR content ranging from 12.61-13.80 mmol/l indicating medium hazard prone (Wodeyar & Srinivasan, 1996). Where as Ooguru water samples showed a range of 16.83-19.71 showing more prone to high hazards of Na (Table 1 & 2). All the samples analyzed for Boron Concentration were reported as 0.79 - 0.71 mg/l (W2&W3). The rating of water quality index (WQI) of water samples were calculated and showed in tables 6&7. Oollapalem water samples showed the results of WQI values found to be in the range 31.5-32.4 (CCME, 2001)indicating that they are of poor quality in nature (Tambekaran et al., 2008). Ooguru water samples showed WQI values within the limits(87.60) indicating good quality and also fit for potable purpose.

Table 2. Physico – Chemical Parameters of water samples collected at Ooguru, Prakasam (Dt.) A.P.

Parameter	WW1	WW2	WW3	WW4	WW5	WW6	WW7	WW8	WW9	WW10
pH	6.26	6.65	8.60	6.87	6.94	8.30	8.70	9.60	8.79	7.12
Conductivity (mmhos)	45.5	2.08	2.91	202.8	287.1	262.0	112.8	92.1	2.14	1.22
Turbity (NTU)	4.1	4.2	4.0	3.0	19.9	8.2	18.2	12.5	12.5	2.2
Alkalinity (mg/l)	10	1.5	3	5	15	10	5	20	15	3.5
Total hardness (mg/l)	2700	180	370	2400	2000	4000	10000	8500	420	220
Ca-hardness (mg/l)	300	40	120	300	2100	1800	1200	1400	160	20
Mg hardness (mg/l)	2200	130	150	1800	2900	1200	2700	3900	260	200
Total solids(mg/l)	42.63	1.6	2.3	35.6	38.06	89.3	75.4	94	9.16	9.8
Total dissolved solids (mg/l)	19.23	4.2	3.43	4.6	56.2	20.7	26.9	60.0	9.0	8.2
Total suspended solids (mg/l)	13.4	2.6	11.13	51	1.8	8.6	28.44	22.94	2.84	2.4
Chlorides (mg/l)	398.0	67.0	49.18	597.3	160.7	999.6	597.0	797.2	469.8	104.9
Nitrates (mg/l)	0.15	2.13	3.36	0.9	2.33	3.53	32.6	3.16	0.16	0.5
Phospates (mg/l)	0.33	0.24	0.1	0.93	6	0.53	0.36	0.63	0.26	0.73
Sulphates (mg/l)	18.5	5.63	12.66	7.13	9.16	42.53	43.63	38	21.83	6.16
D. O (mg/l)	1.5	2.7	3.7	4.8	8.9	7.4	6.8	7.1	0.5	0.2
B.O.D (mg/l)	1.2	1.7	0.17	3.4	3.2	2.2	3.9	3.5	1.7	0.5
C.O.D(mg/l)	1.4	1.9	3.6	8.2	4.8	7.2	4.2	4.8	4.1	0.5
Bo (mg/l)	0.501	0.12	0.56	0.72	0.32	1.17	0.81	0.55	0.60	0.49
Na(mg/l)	1238	225.4	294.4	2681	3880	1383	2043	2060	35.3	9.4
K(mg/l)	185.6	116.5	91.2	339.0	345.4	296.6	307.6	319.2	44.6	2.4
SAR (mml/l)	17.60	19.71	16.83	20.77	24.07	20.92	0.27	41.59	2.43	0.22

Table 3. Standards for Drinking Water

	P arameter	Indian Stds.		ICMR		WHO		CPCB	
		P	E	P	E	P	E	P	E
		PHYSICAL NATURE							
1	Colour	10	40	5	20	5	25	------	
2	Taste & Odour	Unobjectionable				Unobjectionable			
3	Turbidity	10	25	5	25	5	25	------	
4	pH	6.5-8.5	6.5-8.2	7	6.5-7.2	7-8.5	6.5-9.2	8.5	
							CHEMICAL SUBSTANCES		
5	Total Solids	--------		---	500	500	1500	----	
6	Total Hardness	300	600	600	---	----	---		300
7	Ca Hardness	75	200	200	75	75	200		75
8	Mg Hardness	30	100	150	50	50	150		30
9	Cu	0.05	105	3.0	1.0	1.0	1.5	------	
10	Fe	0.3	1.0	1.0	0.3	1.0	1.5	------	
11	Mn	0.1	0.5	0.5	0.1	0.1	0.5	------	
12	Chlorides	250	1000	1000	200	200	600	250	-----
13	Sulphates	150	400	400	200	200	400	200	----
14	Nitrates	45	----	50	----	----	----	50	100
15	Fluorides	0.6	1.2	----	2.0	0.5	0.5	1.0	1.5
16	Phenolic Subs.	0.001	0.002	0.00	0.001	0.001	0.002	----------	
						TOXIC SUBSTANCES			
17	Arsenic	0.05	-----	0.2	----	-----	0.2	----------	
18	Cd	0.05	------	0.05	----	-----	0.2	------	
19	Cyanide	0.05	---	0.01	---	--	0.01	------	
20	Lead	0.1	---	0.1	---	--	0.01	----	
21	Selenium	0.01	---	0.05	---	--	0.01	----------	
22	Zinc	5.0	10	-----		-----		--------	
23	Mercury	0.01	---	------		-----		-------	
24	Bacteriological	------		--------		------		-------	

- P = Permisssible limit
- E = Excessive limit
- ICMR = Indian Council of Medical Research
- BIS = Beauro of Indian Standards
- CPCB = Central Pollution Control Board

Table 4. Rating of Water Quality Index

S.No.	Water Quality Index	Water Quality Rating
1.	95-100	Excellent
2.	80-94	Good
3.	65-79	Fair
4.	45-64	Marginal
5.	0-44	Poor

Table 5. Water Quality Index for Analysed Samples

Name of the District	Name of the village	Water Quality Index	Grades Given
Prakasam	Oollapalem		
	W1	39.563	Poor
	W2	39.563	Poor
	W3	38.425	Poor
	W4	29.583	Poor
	W5	29.583	Poor
	W6	41.453	Poor
	W7	39.688	Poor
	W8	41.769	Poor
	W9	39.224	Poor
	W10	39.746	Poor
Prakasam	Ooguru		
	WW1	84.10	Good
	WW2	87.60	Good
	WW3	82.61	Good
	WW4	82.46	Good
	WW5	80.79	Good
	WW6	83.46	Good
	WW7	84.46	Good
	WW8	82.51	Good
	WW9	84.26	Good
	WW10	88.60	Good

CONCLUSION

Analysis of water samples revealed that the high load of hardness, chlorides, Ca , Mg and Na of the saltpan effluent caused remarkable increasing values in all these parameters in water. The findings clearly indicated that the salinity has been found in water resources. Water quality has undergone severe degradation due to gross alteration values of pH, hardness, Chlorides and Na. Findings thus strongly suggest that there is need of proper treatment of effluents from saltpans prior to release into the neighboring water bodies to protect the aquatic environment and human beings. The findings clearly indicated that saline effluent has polluted water and the results obtained indicate us that the detrimental impact of saline effluent on water quality rendering it unsuitable for the propagation of life and is unfit for agricultural purposes.

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